Patent Application
Docket No. 28170-11USPT

METHOD FOR IMPROVING THE HANDING OVER A CONNECTION FROM ONE SGSN TO ANOTHER SGSN

CROSS-REFERENCES TO RELATED APPLICATIONS

This Application for Patent claims the benefit of priority from, and hereby incorporates by reference the entire disclosure of, co-pending U.S. Application for Patent Serial No. 09/222,444 filed December 29, 1998 and Norwegian patent application No. 19976150, filed on December 30, 1997.

BACKGROUND OF THE PRESENT INVENTION

Field of the invention

The present invention relates to a method for improving the handing over of a connection from one SGSN to an- other, i.e. when an MS (Mobile Station) moves from one SGSN service area to another, and more specifically, the present invention relates to GPRS service on GSM.

Background of the invention

When a mobile station (MS) in an active GPRS modus, i.e. transmitting information, moves from one SGSN service area to another, the packet transmission and possible layer 3 procedures should not be interrupted. As is understood in the art, the layer 3 procedures relate to the seven layers of the ISO (International Standardization Organization) OSI (Open System Interconnect) model where layer 3 deals with network related signaling procedures. Network related procedures are procedures needed in order to have a functional communication network supporting, for example, mobility management in a mobile telephony system.

Due to the complex state machines for the layer 3 procedures, changing SGSN directly implies transmitting very large amounts of control data from one SGSN to another. Another problem is ongoing transactions with other network nodes which also has to be redirected to the new SGSN.

State of the art

GSM voice service uses an anchor concept to solve the problem. That means that in the network node (SC/VLR) a connection is primarily established and is kept through-out the whole call. This node is entitled `anchor MSC/VLR'. If the subscriber moves into another MSC/VLR's coverage area,

the new MSC/VLR acts only as a transmit node. This node is entitled `serving MSC/VLR' whereas the connection control still resides in the anchor MSC/VLR throughout the call.

Problems related to prior art

GPRS has no working solution on this problem yet. Due to the long connection times for GPRS (hours) compared to a circuit switched connection (minutes), a similar solution for GPRS may result in a great number of anchor-serving legs.

OBJECTS OF THE INVENTION

An object of the present invention is to provide a method for improving the handing over of a connection from one SGSN to another, whereby the packet transmission and possible layer 3 procedures are not interrupted.

Another object of the present invention is to provide such a method by which the layer 3 procedures do not have to be designed for supporting inter SGSN routing area update.

Still another object of the present invention is to provide a method by which the tunneling of payload packets from one SGSN to another is not required, thereby simplifying the design necessary therefor.

Still another object of the present invention is to provide a method which optimizes the network utilization without adding complexity to SGSN.

Another object of the present invention is to provide a method by which the service degradation is minimized when handing over a connection from one SGSN to another as experienced from the MS point of view.

A more complete appreciation of the present invention and the scope thereof can be obtained from the accompanying drawings which are briefly summarized below, the following detailed description of the presently-preferred embodiments of the invention, and the appended claims.

Summary of the invention

In a method as stated in the preamble, the above objects are achieved by the features as stated in the enclosed patent claims.

In other words, the present method suggests that at inter SGSN routing area update, the old SGSN gets the role as a temporary anchor whereas the new SGSN works temporarily as a serving SGSN. This leg is kept as long as connection control procedures are processing including data packet transmission. When all activities have ceased for the connection, i.e. no data transmission, no layer 3 procedures

and no on-going transactions towards other networks nodes, the connection control is moved from old to new SGSN.

The leg between old and new SGSN may be a Gb interface without or, alternatively, with minor modifications. Some control signaling is used to handle radio resources.

Further features of the present method will appear from the following description taken in conjunction with the appending drawings, as well as from the enclosed patent claims.

BRIEF DESCRIPTION OF THE DRAWINGS

Figs. 1A and 1B represent a first step of a signaling sequence of an inter SGSN routing area update;

Figs. 2A and 2B represent a second step of the signaling sequence of the inter SGSN routin area update of Figs. 1A and 1B; and

Fig. 3 is an exemplary block diagram of infrastructure of a communication network for supporting the signaling sequence according to Figs. 1A, 1B, 2A, and 2B.

DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EXEMPLARY EMBODIMENTS

The present invention will now be described more fully hereinafter with reference to the accompanying drawings, in which preferred embodiments of the invention are shown. This

invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art.

The present invention relates to a method to "hand over" a connection from one SGSN to another without interrupting packet transmission and control signaling. The method allows the network to create a temporary leg between the old and the new SGSN. The temporary leg is maintained until the state of the connection in the old SGSN can be securely transferred to the new SGSN while at the same time redirecting packet transfer to go directly from/to the old SGSN to/from the new SGSN.

With reference to FIGS. 1A, 1B, 2A, and 2B, it is illustrated by means of a signaling sequence how the principle of an inter SGSN routing area update is carried out in two steps. FIGS. 1A, 1B represent a first step and FIGS. 2A, 2B represent a second step of the signaling sequence. It should be understood that intra and inter SGSN routing area updates are well known in GPRS systems as described in the ETSI specification "ETSI EN 301 344" (also known as "GSM 03.60").

This two-step construction does not impact on-going layer 3 procedures or payload transmission. Actually, the layer 3 procedures do not have to be designed to support inter SGSN routing area updates since the temporary Gb channel is not visible for layer 3. Today's solution in GPRS require that all layer 3 procedures must be designed to cater for inter SGSN routing area updates.

Since context take-over from an old (i.e., temporary anchor) to a new SGSN takes place when the connection has entered a standby state, the risk for losing payload packets is minimized. And since there is no traffic on-going, the tunneling of payload packets from the old to new SGSN is not required, thereby simplifying the design.

Using the old SGSN as a temporary anchor simplifies signaling between SGSN and external nodes since the connection of a GGSN to the old SGSN is allowed to finish up on-going transactions before moving the context to the new SGSN. For example, services, such as charging, may be completed towards a billing gateway in the normal manner before the context is moved to the new SGSN and charging is resumed. It should be understood that "charging" is a term well understood in the art and denotes functions in telecommunication nodes dealing with collecting of information relating to

individual calls and sessions for later processing and production of customer bills.

Referring to FIGS. 1A, 1B, 2A, and 2B, exemplary signaling sequence layouts depicting the principles of how an inter SGSN routing area update is carried out in two steps 100a and 200a are illustrated. FIGS. 1A and 2A illustrate signaling sequence layouts in an interconnect format and FIGS. 1B and 2B are corresponding flow charts.

Referring to FIG. 1A, when a mobile station (MS) 105 moves from one SGSN service area to another, the MS 105 communicates an inter SGSN routing area update signal 110 to the new SGSN 115. A temporary leg 135 or Gb channel is created between the MS 105 and the new SGSN 115 via the old SGSN 125 by the new SGSN 115 communicating an "establish GB channel" signal 120 to the old SGSN 125 and the old SGSN 125 responding by communicating an "establish GB channel acknowledgment" signal 130 to the new SGSN 115. As such, the old SGSN 125 is given the role as temporary anchor while the new SGSN 115 is temporarily working as a serving SGSN. The inter SGSN routing area update procedure 140 is then performed. Packet transfer is redirected at 145, which includes other layer 3 procedures and payload data to be forwarded from the old SGSN 125 to the new SGSN 115 over the temporary leg 135. It should be understood that a Gb channel (i.e., interface)

is well known GPRS terminology as described in the ETSI specification, "ETSI EN 301 344" (also known as "GSM 03.60") version 7.4.0, chapter 12.6.

Referring to FIG. 1B, a flow diagram 100b of the first step of a signaling sequence according to the signaling sequence layout 100a of FIG. 1A is shown. The signaling sequence 100b starts at step 150. At step 110, the new SGSN receives the "routing update message" from the mobile station (MS) 105. At step 112, a temporary leg 135 is created between the old and new SGSN by communicating the "Est. Gb channel" 120 and the "Est. Gb channel acknowledgment" 130 signals between the old 125 and new 115 SGSN.

At step 140, the routing update procedure is run between the MS 105 and the new SGSN 115 via the old SGSN 125. At step 145, the old SGSN 125 redirects (forwards) payload traffic received from a GGSN to the new SGSN 115 and vice versa. Additionally, at step 145, packet transfer is redirected, which includes the old SGSN 125 forwarding layer 3 procedures (i.e., mobility management (MM) signaling) and payload traffic (voice and data) received from the MS 105 to the new SGSN 115 and vice versa. At step 155, the process ends.

Referring to FIG. 2A, when the connection enters a standby state (e.g., when all activities, such as layer 3

procedures, data transmission or on-going transactions toward other networks nodes, have ceased), the connection is securely transferred to the new SGSN 115 by moving the context from the old SGSN (i.e., temporary anchor) 125 to the new SGSN 115 without impacting on-going layer 3 procedures or packet data transmission. The term "connection control" means to maintain communication paths in telecommunication networks, where each telecommunication node (e.g., telephony exchanges) along the communication path provide such mechanisms. When the communication path is changed during a communication session because of an inter SGSN routing area update in GPRS, the connection control is transferred from one SGSN to another in order to maintain the communication path.

To move the context from the old SGSN 125 to the new SGSN 115, the old SGSN 125 sends a "context forward" signal 210 to the new SGSN 115. An inter SGSN routing area update 215 between a gateway GPRS support node (GGSN) 205 and the new SGSN 115 is performed so as to switch to the new SGSN 115. The new SGSN 115 then sends a "context forward acknowledgment" signal 220 to the old SGSN 125, thereby enabling subsequent payload traffic to be communicated directly between the GGSN 205 and the new SGSN 115 without being forwarded or redirected through the old SGSN 125. The

temporary leg 135 (e.g., Gb channel) between the old SGSN 125 and the new SGSN 115 may then be released 225. It should be understood that the old SGSN 125 stops collecting charging information at a time when no chargeable events occur and charging resumes in the new SGSN 115 when the connection control has been transferred.

Referring to FIG. 2B, a flow diagram 200b of the second step of a signaling sequence according to the signaling sequence layout 200a of FIG. 2A is shown. The signaling sequence 200b starts at step 230. At step 235, the old SGSN establishes that the MS has entered a standby state and that no signaling activities relating to the MS are on-going. The standby state is defined in ETSI specification "ETSI EN 301 344" (also known as "GSM 03.60"), version 7.4.0, chapters 6.1.3 and 6.2.1. It should be understood that the decision to go to the standby state is part of the connection control, which at this time is maintained in the old SGSN 125. Upon establishing that the MS is in a standby state and that signaling activities related to the MS 105 are not on-going, the old SGSN 125 sends a connection state to the new SGSN 115 via a "context forward" message at step 210.

The routing update of step 215 (FIG. 2A) is performed by three operations, 215a-215c. At step 215a, the new SGSN 115 initiates completion of the "routing update", which was

originally initiated in the first step 100a (FIG. 1A). The new SGSN sends the "routing update" message to the old SGSN 125. At step 215b, the old SGSN 125 sends the "routing update" further on to the GGSN 205, which enables the GGSN 205 to route payload traffic to the new SGSN 115 thereafter. At step 215c, the new SGSN 115 is informed that the GGSN 205 has been enabled to route payload traffic directly to the new SGSN 115.

At step 220, the new SGSN 115 acknowledges receipt of the connection state by sending 220 the "context forward ack." message to the old SGSN 125. The "context forward ack." message implies that the new SGSN 115 has released the temporary leg 135 established in the first step (FIG. 1A) of the signaling sequence and the old SGSN 125 also releases the temporary leg 135 upon receiving the message. After the new SGSN 115 acknowledges the connection state, the payload traffic is communicated between the GGSN 205 and the new SGSN 115 at step 225. The second step 200b of the signaling sequence ends at step 235.

FIG. 3 is an exemplary block diagram of infrastructure of a communication network 300 according to the principles of the present invention. The GGSN 205 is connected to an external network 305, such as the Internet or a public switched telephone network (PSTN). The GGSN 205 further

connects to at least two serving GPRS support nodes (SGSN) 125 and 115. A first SGSN 125 is connected to a base station controller 310a, which controls base stations (not shown) that communicate with mobile stations (not shown) within a radio network 315a. A first SGSN 115 is connected to a base station controller 310b, which controls base stations (not shown) that communicate with mobile stations (not shown) within a radio network 315b. Gb channels 320 couple the SGSNs 125, 115 to their respective base station controllers 310a, 310b.

The SGSNs 125 and 115 are termed "old" and "new", respectively, to exemplify a mobile station (MS) initially operating in the radio network 315a and traveling to and operating in the radio network 315b. While the MS 105 operates in the radio network 315a, the SGSN 125 handles the communication between the base station controller 310a and the GGSN 205. Upon the MS moving to operate within the radio network 315b, the SGSN 115 begins to handle the communication between the base station controller 310b and the GGSN 205. At the switchover between the old SGSN 125 and the new SGSN 115, a Gb channel 135 is created. The temporary leg or Gb channel 135 is established and operates as described in conjunction with FIGS. 1A-2B.

Merits of invention

The solution optimizes the network utilization without adding complexity to SGSN. The subscriber does not experience any loss of service i.e., no retransmission peer to peer and no interrupted layer 3 procedures.

List of Abbreviations

GPRS - General Packet Radio Service

SGSN - Serving GPRS support node

GGSN - Gateway GPRS support node

MSC/VLR - Mobile Switching Center/Visitor Location Register

METHOD FOR IMPROVING THE HANDING OVER A CONNECTION FROM ONE SGSN TO ANOTHER SGSN

Field of the invention

The present invention relates to a method for improving the handing over of a connection from one SGSN to another, i.e. when an MS (Mobile Station) moves from one SGSN service area to another.

Background of the invention

More specifically the present invention relates to GPRS service on GSM.

When a mobile station (MS) in active GPRS modus, i.e. transmitting information, moves from one SGSN service area to another, the packet transmission and possible layer 3 procedures should not be interrupted.

Due to the complex state machines for the layer 3 procedures, changing SGSN directly implies transmitting very large amounts of control data from one SGSN to another. Another problem is ongoing transactions with other network nodes which also has to be redirected to the new SGSN.

State of the art

GSM voice service uses an anchor concept to solve the problem. That means that in the network node (MSC/VLR) a connection is primarily established and is kept throughout the whole call. This node is entitled 'anchor MSC/VLR'. If the subscriber moves into another MSC/VLR's coverage area, the new MSC/VLR acts only as a transit node. This node is entitled 'serving MSC/VLR' whereas the

connection control still resides in the anchor MSC/VLR throughout the call.

Problems related to prior art

GPRS has no working solution on this problem yet. Due to the long connection times for GPRS (hours) compared to a circuit switched connection (minutes), a similar solution for GPRS may result in a great number of anchor-serving legs.

Objects of the invention

An object of the present invention is to provide a method for improving the handing over of a connection from one SGSN to another, whereby the packet transmission and possible layer 3 prosedures are not interrupted.

Another object of the present invention is to provide such a method by which the layer 3 procedures do not have to be designed for supporting inter SGSN routing update.

Still another object of the present invention is to provide a method by which the risk of losing payload packets is minimized.

Yet another object of the present invention is to provide a method by which the tunnelling of payload packets from one SGSN to another is not required, thereby simplifying the design necessary therefor.

Still another object of the present invention is to provide a method which optimizes the network utilization without adding complexity to SGSN.

Another object of the present invention is to provide a method by which the service degration when handing over a

connection from one SGSN to another is minimized as experienced from the MS point of view.

Brief disclosure of the invention

In a method as stated in the preamble, the above objects are achieved by the features as stated in the enclosed patent claims.

In other words, the present method suggests that at inter SGSN routing update, the old SGSN gets the role as a temporary anchor whereas the new SGSN works temporarily as a serving SGSN. This leg is kept as long connection control procedure are processing including data packet transmission. When all activities have ceased for the connection, i.e. no data transmission, no layer 3 procedures and no on-going transactions towards other networks nodes, the connection control is moved from anchor to serving SGSN.

The leg between anchor and serving SGSN is a Gb interface with minor modifications. Some control signalling is required to handle radio resources.

Further advantages and features of the present method will appear from the following description taken in conjunction with the appending drawings, as well as from the enclosed patent claims.

Brief disclosure of the drawings

Fig. 1 and Fig. 2 are signalling sequence layouts, illustrating the principle of how inter SGSN routing update is carried out in two steps.

Description of embodiments

As explained in the preamble, the present invention relates to a method method to "hand over" a connection from one SGSN to another without interrupting packet transmission and control signalling. The method allows the network to create a temporary leg between the old and the new SGSN. The temporary leg prevails until the state of the connection in the anchor SGSN can be securely transferred to the new SGSN while at the same time redirecting packet transfer to go directly from/to SGSN to/from the new SGSN.

With reference to Fig. 1 and Fig. 2 it is illustrated by means of a signalling sequence how the principle of inter SGSN routing update is carried out in two steps.

This construction has the advantage of not impacting ongoing layer 3 procedures and any payload transmission. Actually, the layer 3 procedures do not have to be designed to support inter SGSN routing update since the temporary Gb channel is not visible for layer 3. Today's solution in GPRS require that all layer 3 procedures must be designed to cater for an inter SGSN routing update.

Since the context take-over from temp. anchor to new SGSN takes place when the connection has entered a standby state, the risk for loosing payload packets is minimised. And since there is no traffic ongoing, the tunnelling of payload packets from temp. anchor to new SGSN is not required, thereby simplifying the design.

The temp. anchor principle also simplifies signalling to between SGSN and external nodes. Since the solution allows the connection to finish up ongoing transactions before moving the context to new SGSN, services such as

charging may be completed towards billing gateway in the normally manner before the context is moved to the new SGSN and charging is resumed.

Merits of invention

The solution optimises the network utilisation without adding complexity to SGSN. The subscriber will not experience any loss of service i.e., no retransmission peer to peer and no interrupted layer 3 procedures.

List of Abbreviations

GPRS - General Packet Radio Service
SGSN - Serving GPRS support node
GGSN - Gateway GPRS support node
MSC/VLR - Mobile Switching Centre/Visitor Location Register

Patent claims

1. Method for improving the handing over of a connection from one SGSN (I) to another, i.e. when an MS (Mobile Station) moves from one SGSN service area to another,
c h a r a c t e r i z e d i n that at inter SGSN routing update, the old SGSN (I) is given the role as a temporary anchor, whereas the other (new) SGSN (II) is temporarily working as a serving SGSN.

2. Method as claimed in claim 1,
c h a r a c t e r i z e d i n that at said inter SGSN routing update there is created a temporary leg between the old SGSN (I) and the new SGSN (II), said temporary leg being allowed to prevail as long as connection control procedure is upheld, including data packet transmission.

3. Method as claim in claim 1 or 2,
c h a r a c t e r i z e d i n that the temporary leg is allowed to prevail until the state of the connection in the anchor SGSN (I) can be securely transferred to the new SGSN (II), while at the same time redirecting packet transfer to go directly from/to SGSN (I) to/from the new SGSN (II).

4. Method as claimed in claim 3,
c h a r a c t e r i z e d i n that connection control is moved from said anchor SGSN (I) to said serving SGSN (II) when all activities for the connection have ceased, i.e. when no data transmission, no layer 3 procedure and no on-going transactions towards other network nodes prevail.

5. Method as claimed in any of the preceding claims,

c h a r a c t e r i z e d i n that the leg between the anchor SGSN (I) and the serving SGSN (II) is created as a Gb interface with minor modifications.

6. Method as claimed in any of the preceding claims, c h a r a c t e r i z e d i n that the inter SGSN routing update is carried out in a two step signalling sequence, and then without impacting on-going layer 3 procedures and any payload transmission, said temporary Gb channel not being visible for said layer 3.

7. Method as claimed in claim 6, c h a r a c t e r i z e d i n that said signalling is carried out between SGSN and external nodes, allowing the connection in question to finish on-going transactions before moving the context to a new SGSN (II), services such as charging being completed towards billing gateway in a normal manner before the context is moved to the new SGSN (II) and charging resumed.

Abstract

The present invention relates to a method for improving the handing over of a connection from one SGSN (I) to another, i.e. when an MS (Mobile Station) moves from one SGSN service area to another, and for the purpose of not interrupting the packet transmission and possible layer 3 procedures, and for optimizing the network utilization without adding complexity to SGSN, it is according to the invention suggested that at inter SGSN routing update, the old SGSN (I) is given the role as a temporary anchor, whereas the other (new) SGSN (II) is temporarily working as a serving SGSN.

Fig. 1 and 2

FIG.1

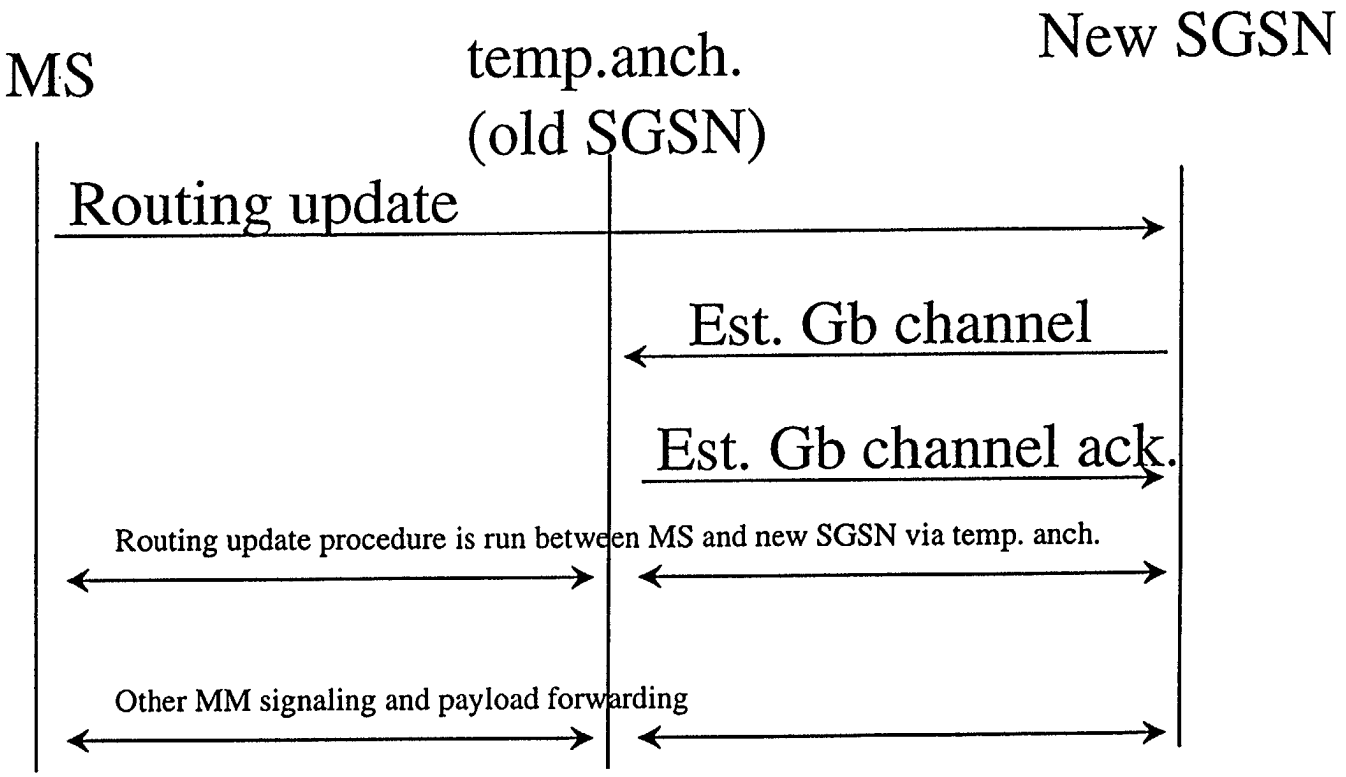
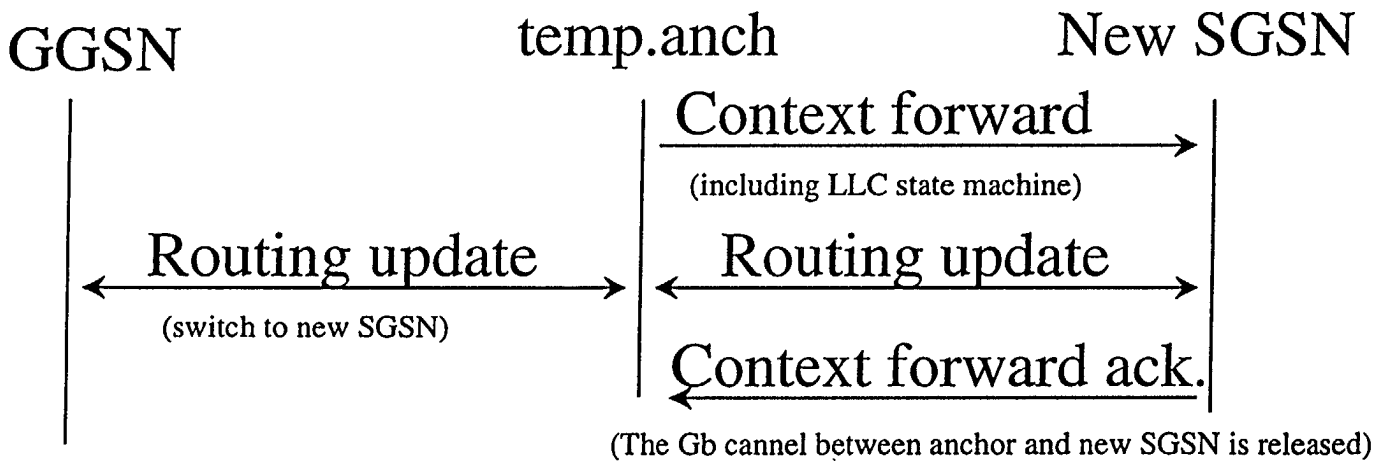

MS
temp.anch.
(old SGSN)
New SGSN
Routing update
Est. Gb channel
Est. Gb channel ack.
Routing update procedure is run between MS and new SGSN via temp. anch.
Other MM signaling and payload forwarding

FIG.2

When the connection enters standby state and no layer 3 procedures are ongoing the following procedure apply



(The Gb cannel between anchor and new SGSN is released)